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Disciseda bovista, recently collected from northern Italy, and *Lycoperdon defossum*, a synonym of *D. candida*

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Abstract — The rare *Disciseda bovista* is described from northern Italy (Piedmont) based upon a recent collection. This is the second documented collection of the species from Italy, and the first in recent times. The study of Vittadini's original material labelled as *Lycoperdon defossum*, a taxon considered by many authors as a synonym of *D. bovista*, reveals that it should be ascribed to *D. candida* and, as such, represents the first record of the species from Italy.

Key words — *Agaricales, Lycoperdaceae, Catastoma,* red lists, taxonomy

Introduction

Disciseda Czern. (= *Catastoma* Morgan) is a genus belonging to the gasteroid lineage of the *Agaricaceae* Chevall. s.l. (Bates et al. 2009, Gube 2009), where it forms the *Disciseda*-clade (Larsson & Jeppson 2008), which is basal to the rest of the taxa formerly placed within the *Lycoperdaceae* Chevall. The genus has a worldwide distribution, but all the species are restricted to xeric habitats. In the latest edition of the Dictionary of the Fungi (Kirk et al. 2008), fifteen *Disciseda* species are recognized.

The genus is characterized by semi-hypogeous basidiomes with a loose mycelial connection, and a peculiar type of dehiscence (e.g. Mattirolo 1934, Ahmad 1950, Mitchel et al. 1975, Jeppson 1997, Calonge 1998, Moreno et al. 2003). The ostiole develops in the basal zone of the endoperidium; then the exoperidium cracks along the circumference of the basidiome and the upper part gets detached from its hypogean portion. When disturbed by atmospheric agents, the detached basidiome will turn over and, consequently, exposes the basal portion of the endoperidium, which places the ostiole in the apical

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position. The portion of the exoperidium that initially covered the apical parts of the semi-hypogeous basidiome remains attached to the base as a kind of cap encrusted with soil particles and vegetal debris. Kreisel (1962) termed these fungi 'geanemochorous tumblers', since the whole basidiome is blown by the wind, causing basidiospore dispersal.

This paper reports on the occurrence of the rare and threatened *Disciseda bovista* in Piedmont, northern Italy, and provides observations on previous Italian collections. Furthermore, we provide our analysis of Vittadini's collection originally labelled *Lycoperdon defossum*, a taxon considered by some mycologists to represent a synonym of *D. bovista*.

Material and methods

The macro- and micromorphological features are described from notes taken from fresh material. The micromorphological features were observed from dried material mounted in distilled water and Congo red. Spore size is expressed both as a range and mean value based on 26 randomly chosen basidiospores. Basidiospore measurements do not include either sterigma or ornamentation.

Author citations follow Index Fungorum (http://www.indexfungorum.org/Names/AuthorsOfFungalNames.asp). Herbarium abbreviations are according to Thiers (2010).

Taxonomy

Disciseda bovista (Klotzsch) Henn., Beiblatt zur Hedwigia 42: 128, 1903, sub "Lloyd, G.G. *Catastoma*". FIGS. 1a–g

≡ *Geastrum bovista* Klotzsch, Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 19(Suppl. 1): 243, 1843.

≡ *Catastoma bovista* (Klotzsch) Hollós, in Hennings, Verh. Bot. Vereins Prov. Brandenburg 43: VI, 1901.

= *Globaria debreceniensis* Hazsl., Verh. Zool.-Bot. Ges. Wien 26: 226, 1876.

≡ *Bovista debreceniensis* (Hazsl.) De Toni, Sylloge Fungorum 7: 476, 1888.

≡ *Catastoma debreceniense* (Hazsl.) Hollós, Termés. Közl. 56: 186, 1900.

≡ *Disciseda debreceniensis* (Hazsl.) Hollós, Termés. Füz. 25: 102, 1902.

= *Bovista subterranea* Peck, Bot. Gazette (Crawfordsville) 4(10): 216, 1879.

≡ *Catastoma subterraneum* (Peck) Morgan, J. Cincinnati Soc. Nat. Hist. 14: 143, 1892.

≡ *Disciseda subterranea* (Peck) Coker & Couch, Gast. East. U.S. and Canada: 141, 1928.

SELECTED DESCRIPTIONS: Kers (1975: 420–427); Calonge (1998: 79–80).

SELECTED ICONOGRAPHY: Mattirolo (1934: FIGS. 1–16); Kers (1975: FIG. 2); Jeppson (1997: FIG. 1); Jordal et al. (2007: FIG. 1).

BASIDIOME (8–)10–26 mm in diam. × 9–15 mm in height, globose, subglobose, regular to gibbous, sometimes lobed and depressed, mottled. Immature basidiomes completely enveloped by the exoperidium (Fig. 1a) resembling the protective cases of some trichopteran larvae. Mature basidiomes enveloped at the base by remnants of the exoperidium that forms a thick mycelial pad, heavily

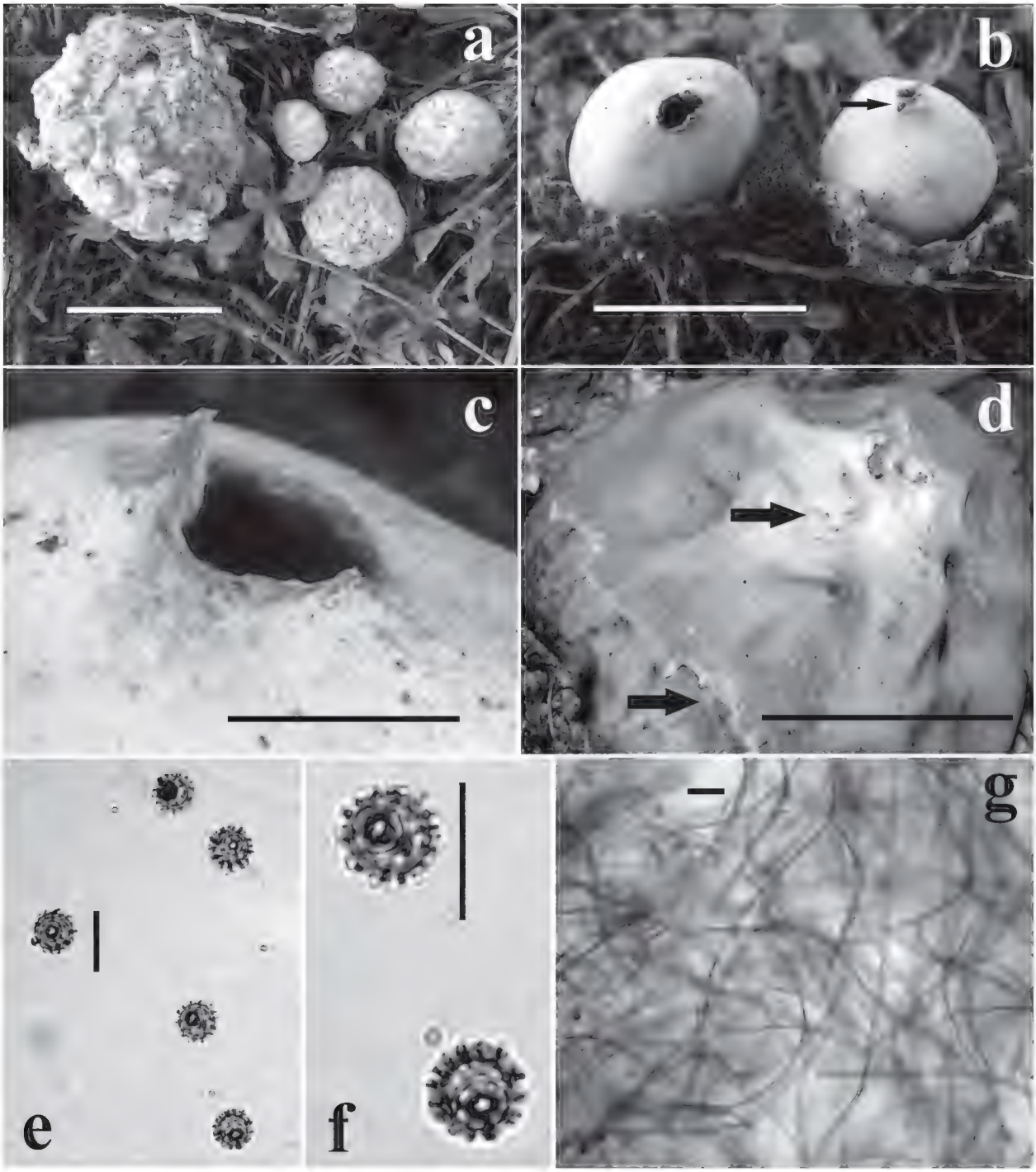

FIGURE 1. *Disciseda bovista* (TO HG1998). a. Immature basidiomes with intact and encrusted exoperidium. b. Ripe and inverted basidiomes with crumbling exoperidium; arrow = double ostiole. c. Ostiole. d. Mottled endoperidium lacking an evident ostiole, with remnants of the pseudoparenchymatic exoperidial layer (arrows). e, f. Basidiospores. g. Capillitium. Bars: a = 10 mm; b = 20 mm; c = 2mm; d = 20 mm; e, f = 10 µm; g = 20 µm.

encrusted with plant debris and particles of soil (FIG. 1b). Old basidiomes often colonized by green algae. OSTIOLE (1–)2 mm in diam., orbicular to irregularly-shaped and torn (FIG. 1c); in some ripe specimens no ostiole has been observed; occasionally additional little ostioles are present. EXOPERIDIUM colour very difficult to discern as the exoperidium is heavily encrusted with debris,

whitish to greyish brown. Endoperidium white to light grey, then yellowish-brown, coriaceous, leathery, persistent, glabrous to rimulose-pubescent, often with small patches, remnants of the pseudoparenchymatic exoperidial layer (Fig. 1d). Gleba light brown to dark brown, cottony at first, soon becoming pulverulent.

Basidiospores (5.8–)6.0–7.4(–7.6) × (5.5–)5.8–7.0(–7.1) µm, on average 6.68 × 6.38 µm, Q = 1.0–1.07, Qm = 1.046 (*n* = 26), globose, baculate, *Terfezia*-like, warts cylindrical or truncate-conical, up to 0.5–1 µm long, yellowish brown in water mounts, with a central to eccentric large oil drop (Fig. 1e, f); sterigmal remnants (pedicels) short (up to 2–3 µm in length) or absent. Capillitium of the *Lycoperdon*-type, 2.5–5 µm in diam., with rounded tips, thick-walled (up to 1.0 µm), fragile, pale brown in water mounts, straight to undulate, rarely finely encrusted, sometimes with small-sized pores, septate, often disarticulating at the septum, occasionally with dichotomous branching (Fig. 1g). Exoperidium two-layered: (1) outer mycelial layer, with 2–4 µm wide hyphal elements, interwoven with plant matter and particles of soil; (2) inner pseudoparenchymatous layer, gelatinous, up to 1 mm thick, made up of 10–20 µm in diam., rounded, thin-walled cells. Endoperidium consisting of 2–5 µm wide, thin and thick walled hyphae.

Habitat. Terrestrial, found in an ex-vineyard arid soil partially covered with xerophilic mosses.

Material examined – ITALY: Piedmont, Perosa Canavese (Torino), 45° 23' 55.19" N, 7° 50' 02.14" E, 262 m a.s.l., 10 Dec. 2009, *legit* L. Panno, *det.* A. Vizzini (TO HG1998).

Discussion

Distributed in Europe and America (Coker & Couch 1928, Calonge 1998, Kreisel 2001), where it typically grows in dry, sandy, sunlit and usually steppe-like habitats (Kers 1975, Calonge 1998, Jordal et al. 2007, Stasińka 2008), *D. bovista* is a rare gasteroid species that seems to be declining in Northern Europe. As a consequence, it has been included in the red-lists of rare and threatened macromycetes of several European countries (e.g. Switzerland, Senn-Irlet et al. 1997; The Netherlands, Arnolds & Kuyper 1996; Italy, Venturella et al. 1997; Austria, Krisai-Greilhuber 1999; Denmark, Stoltze & Pihl 1998; Poland, Wojewoda & Ławrynowicz 2004; Sweden, Gärdenfors 2005).

Disciseda bovista is characterized by the 6–7 µm diam., strongly ornamented spores, with *Terfezia*-like, truncate-conical warts, and without long sterigmal remnants. Among the closest allies, *D. candida*, which macromorphologically may be easily confused with *D. bovista*, is clearly distinguished by the smaller (3.5–5.5 µm), finely ornamented basidiospores (e.g. Kers 1975, Jeppson 1986, Mornand 1990, Moyersoen & Demoulin 1996, Calonge 1998, Poumarat et al.

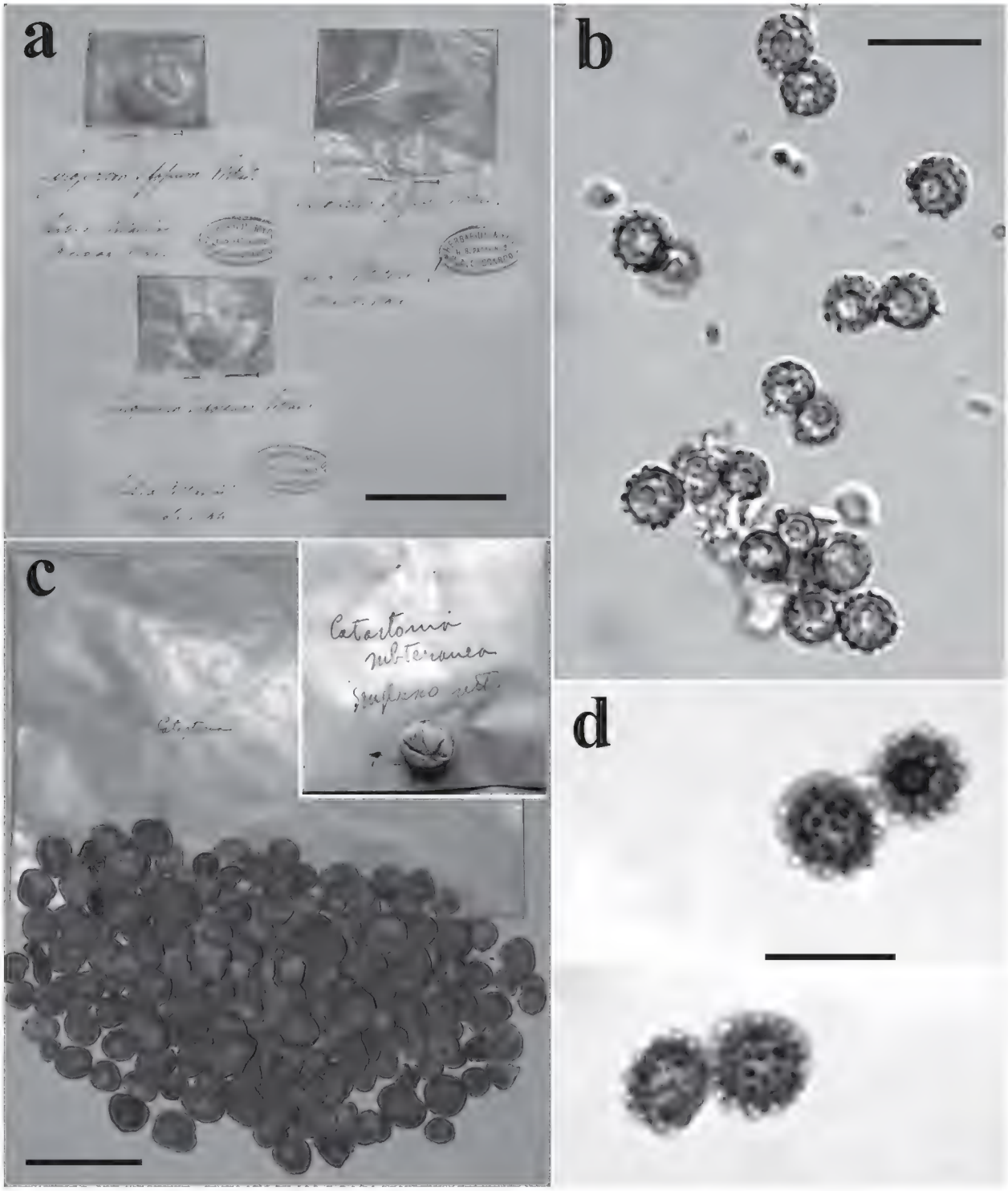

FIGURE 2. a–b. Vittadini's collection (PAD) – *Lycoperdon defossum*. a. Basidiomes. b. Basidiospores. c–d. Mattirolo's collection (TO) – *Catastoma subterraneum*. c. Basidiomes. d. Basidiospores. Bars: a, c = 5 cm; b, d = 10 µm.

2000, Sarasini 2005, Bates et al. 2009). *Disciseda cervina* (Berk.) Hollós has smaller (4.0–5.6 µm), smooth to asperulate basidiospores and an endoperidium often with purplish hues (Hollós 1903, Poumarat 2003, Bates et al. 2009), while the recently described *D. nigra* Dörfelt & H. Nowak from Germany differs in its blackish mature endoperidium and larger basidiospores (7.5–8.5 µm) with warts up to 1.8 µm high (Dörfelt & Nowak 2002).

As regards collections of *D. bovista* previously reported from Italy, the Italian Checklist (Onofri et al. 2005) mentions only one find from Sardinia (Brotzu 1994) included in a local checklist without any supporting data: no description, iconography, observations, or herbarium number were provided. Photos and description of the species, included in the monograph on epigeous gasteromycetes by the Italian specialist Sarasini (2005), refer to Spanish specimens.

Many authors consider *Lycoperdon defossum* Vittad. (Vittadini 1842) a synonym of *Disciseda bovista* [e.g. Petri 1909, Lloyd (Mattirolo 1934), Mattirolo 1934, Calonge 1998; but see Moravec 1958 and Sarasini 2005]. According to Stafleu & Cowan (1986), Vittadini's original specimens are preserved at TO and PAD, which we checked for *L. defossum* collections. The collection cited by Mattirolo (1934) and probably examined by Lloyd (Mattirolo 1934) is missing from TO, but we have located Vittadini's original material in Saccardo's herbarium (PAD). That collection consists of three pressed specimens from Milan (Fig. 2a) with 4–5.5 µm diam., finely to medium ornamented basidiospores (Fig. 2b) that clearly support the material in *D. candida*. This collection represents the first record of the species from Italy.

While studying and sorting out Mattirolo's herbarium of epi- and hypogeous gasteromycetoid fungi housed at TO, we were able to study a very large collection (consisting of over a hundred specimens, Fig. 2c) labelled as *Catastoma subterraneum* made in the Turin hinterland (Mattirolo 1934). Based on spore features, the collection also appears to represent *D. bovista* (Fig. 2d).

In conclusion, our paper describes the second collection — the first in recent times — of *Disciseda bovista* from Italy that can be documented with certainty. We also demonstrate that *Lycoperdon defossum* is not a synonym of *D. bovista*, but rather of *D. candida*:

Disciseda candida (Schwein.) Lloyd, Mycol. Writ. 1: 100, 1902.

= *Lycoperdon defossum* Vittad., Monogr. Lycoperd.: 33, 1842, nom. illegit., non Batsch 1789.

≡ *Globaria defossa* Quél., Bull. Soc. Bot. France 24: 327, 1878, nom. nov.

≡ *Bovista defossa* (Quél.) De Toni, Syll. Fung. 7: 101, 1888.

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